



September 1996

BATTLEFIELD AUTOMATION

Army Land Warrior Program Acquisition Strategy May Be Too Ambitious



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National Security and
International Affairs Division

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Congressional Committees

In November 1995, we reported to the Congress on the Army's efforts to automate a number of battlefield functions through creation of a vast network of computers, sensors, and communications systems that would provide a common, simultaneous picture of the battlefield from soldier to commander.¹ More recently, we examined the Army's Land Warrior soldier system, estimated to cost in excess of \$1.4 billion, and its role in the "digital" battlefield.

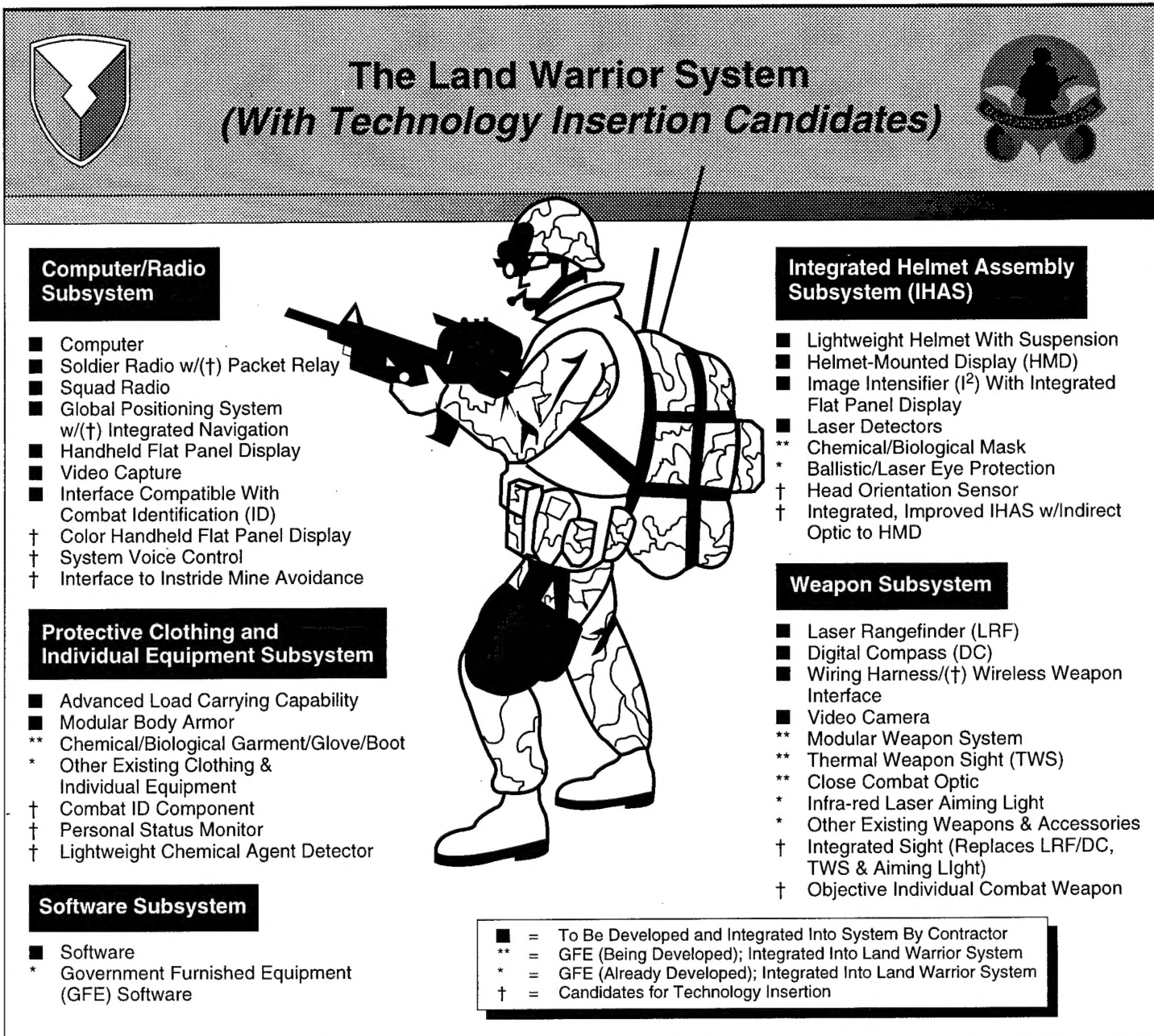
The objectives for this report were to (1) determine the status of various technology and human factor problems associated with system development, (2) evaluate the acquisition strategy for the Land Warrior system, and (3) assess plans to integrate the system with the digital battlefield. We conducted this review under our basic legislative responsibilities and are addressing it to you because the matters discussed in this report fall within your committees' jurisdiction.

Background

The Army developed the Land Warrior program to improve the lethality, mobility, survivability, command and control, and sustainability of infantry soldiers on the battlefield through the integration of a variety of components and technologies. Under the Land Warrior program, the Army is developing a computer/radio, software, integrated headgear (including an imaging display), weapon subsystem, and protective clothing and equipment to be integrated on the individual soldier (see fig. 1). When developed, this equipment is expected to allow soldiers to interface electronically with other battlefield systems. The Army also plans to include a number of additional technologies later that are intended to further enhance the soldier's battlefield performance.

¹Battlefield Automation: Army's Digital Battlefield Plan Lacks Specific Measurable Goals (GAO/NSIAD-96-25, Nov. 29, 1995).

Figure 1: The Land Warrior System



Source: Soldier Systems Command, Project Manager—Soldier.

Land Warrior, which is currently in engineering and manufacturing development, evolved from the Soldier Integrated Protective Ensemble (SIPE) Advanced Technology Demonstration (ATD). SIPE was the Army's first attempt at demonstrating the concept of the soldier as a system. According to the Army, SIPE successfully demonstrated the feasibility of the soldier system concept.

The Army originally planned to demonstrate advanced capabilities in another system known as Generation II Soldier System (GEN II). The GEN II system technologies would have been incorporated as block or component upgrades to Land Warrior, which was considered an interim system.

In November 1995, a Defense Appropriations conference report criticized the Army's plans to acquire what appeared to be two competing systems; the conference report directed the Army to submit a revised acquisition strategy by March 1, 1996, and to accelerate development of the GEN II program. On March 1, 1996, the Army submitted a revised acquisition plan. However, the plan terminated GEN II as a separate program merging it into Land Warrior as a supporting science and technology component.

Results in Brief

Land Warrior is in development, but the program faces a number of technical and human factor problems—including some discovered during the SIPE demonstration—that have yet to be adequately addressed. Although the Army regarded SIPE as successful, for many test conditions, the SIPE-equipped soldiers failed to outperform soldiers using standard equipment. Moreover, the Army has not yet demonstrated that it has overcome this deficiency. Further, the Army may not have fully developed prototypes to test until Initial Operational Test and Evaluation (IOT&E), currently scheduled for August/September 1998. The impact of lingering development problems could affect the system's ability to meet critical performance requirements. In addition, the Army has compressed the schedule by planning overlapping development and operational testing. This could lead to further compromises.

The Army has changed its acquisition strategy to permit more rapid production and deployment. However, according to Army officials, they are still determining which soldiers should receive Land Warrior equipment, and what equipment complement each soldier should carry. Depending on the outcome of such decisions, program procurement could exceed \$1.4 billion. Moreover, the program is not receiving the appropriate management attention because it is incorrectly classified.

Because Land Warrior prototypes have not been available when the Army has tested other components of the digital battlefield, the Army has not demonstrated that Land Warrior can successfully operate in this environment. Thus, there is no assurance that Land Warrior will perform as intended. Further, the Army plans to begin fielding Land Warrior systems before other hardware and software components of the digital battlefield have been proven. According to Army officials, work is in progress to synchronize the fielding of Land Warrior with other digital battlefield elements.

Technology and Human Factors Problems Are Yet to Be Solved

The Army intends to commit to significant Land Warrior production before addressing certain technical and manpower and personnel integration (MANPRINT) problems first identified during SIPE and Land Warrior development. Although the Land Warrior program is scheduled to continue in development for over 2 more years (December 1998) and there is still time to work on solutions, there are some problems that will not be resolved until after production begins.

The Land Warrior program, which evolved from SIPE, has not demonstrated that it has resolved the problem of SIPE-equipped soldiers not performing as well as standard-equipped soldiers, particularly in daylight. For example, the helmet assembly was so heavy and unbalanced that soldiers were typically unable to lift their heads and fire from a prone position. Land Warrior also inherited other SIPE problems involving target recognition, hit performance, navigation, health and safety, and other factors. Moreover, the Army does not plan to address other problems such as the need for micro-climate cooling, further weight reductions in the helmet and helmet mounted display, and laser rangefinder, and enhanced hearing technology² until well after production approval for Land Warrior.

Land Warrior components will be tested before production approval, but the overall system will not be measured against standard-equipped soldiers, as was SIPE. The system will be evaluated against requirements and critical operational criteria outlined in the operational requirements document (ORD). This approach, however, does not require the same "head-to-head" evaluation that SIPE underwent—that is, comparing the performance of SIPE-equipped soldiers with that of soldiers using standard equipment to see which showed greater capability under a variety of conditions.

²Enhanced hearing technology enables the soldier to overhear enemy conversations and detect movement at longer ranges than permitted by natural hearing.

MANPRINT issues disclosed during SIPE and later during Land Warrior development have not yet been resolved, partly because of the development status of the program. These issues include cognitive and physical soldier overload, adverse psychological effects on the soldier, electromagnetic signature emission of the equipment, cumbersome equipment configuration, and other health and safety issues. In April 1996, a MANPRINT risk reduction exercise indicated that although soldiers liked the Land Warrior concept, there were problems with system complexity, government-furnished equipment (GFE) integration, and component interface. For instance, the location of the thermal weapon sight, the laser rangefinder, and close combat optics interfered with certain firing positions. Overall, according to the report, the full complement of Land Warrior equipment was rated very bulky and cumbersome.

Because of development problems, the Army could easily fail to meet its interim goal of having 70 percent capable prototypes available for early operational experimentation (EOE), scheduled for November 1996. Accordingly, production-ready prototypes would not be available for testing until IOT&E, which is just prior to the planned production decision. For example, the Modular Weapon System, which is comprised of mounting rails for sensor attachments, grips, and carrying handles, may not be available for EOE. According to Army officials, this key component of the Land Warrior weapon subsystem recently failed operational testing. The impact is that a surrogate arrangement will be used and Land Warrior sensors will not be tested on their production-configured mounting rails.

The risk of not being able to resolve critical technical problems is increased because of Land Warrior's compressed testing schedule. Although Land Warrior production approval is not scheduled until January 1999, a 6-month bid protest delay in the start of engineering and manufacturing development caused the Army to overlap development testing and operational testing at the end of the development phase. In overlapping development and operational testing, the Army is risking that remaining developmental problems will not be resolved until after production begins.

Land Warrior development has identified other problems that must be resolved prior to production. For example, according to a Land Warrior program official, it is unclear whether the Single Channel Ground and Airborne Radio System (SINGARS)³ can handle high-volume compressed

³The SINGARS radio is the backbone of the Army's tactical internet and serves as the communications link, or "gateway," between the warrior in the field and higher command levels.

data transmission. Another critical function—weapon boresighting and zeroing—had been taking days to complete because of all the sensors that are mounted on the weapon (for example, the thermal weapon sight, laser rangefinder, laser aiming light, and image intensifier). Each sensor must be boresighted (aligned) with the weapon and then the weapon must be “zeroed” for shot accuracy. The proliferation of sensors on the weapon greatly complicates the process. Under battlefield conditions, boresighting and zeroing have to be accomplished very quickly. According to Army officials, the time required for boresighting has recently been reduced to minutes.

Land Warrior Is a High Risk and Costly Acquisition Strategy

The Army estimates total procurement cost for Land Warrior to be \$1.4 billion—exclusive of the cost of GFE—which easily exceeds the threshold for a major system acquisition category (ACAT) II requiring greater oversight.⁴ However, the Army currently regards Land Warrior as an ACAT III program, thus, of less significance than an ACAT II program. Therefore, Land Warrior is not receiving the management attention that it would were it correctly classified as an ACAT II acquisition.

Although correct program classification does not ensure appropriate management attention, it does provide the framework for more intensive oversight and monitoring. The Army requires a higher level milestone decision authority and milestone review forum for ACAT II programs. For example, the milestone decision authority for an ACAT II program would change from the Program Element Office equivalent within Army Material Command to the Army Acquisition Executive.

Land Warrior is a high risk program because the production quantities, system configuration, and testing approach have not been adequately defined. According to the ORD, the Army intends to equip the entire contingency corps, consisting of certain high-priority Army divisions, with Land Warrior systems. As of May 1996, the Army had not determined its Land Warrior acquisition objective:⁵ that is, how many systems will be needed for each unit equipped, including support units; which soldiers should receive them; and what equipment each soldier should carry.

⁴Part I of the Acquisition Management Process Regulations requires that programs for which total production cost exceeds \$645 million in constant fiscal year 1996 dollars be classified as ACAT II, or major systems, and receive greater oversight and monitoring.

⁵During the report commenting period, the Army developed a draft of its acquisition objective. According to Army officials, preliminary estimates now being considered are for 34,000 Land Warrior systems at a cost of \$1.4 billion.

According to the Army, it wants to get whatever improved capabilities it can into soldiers' hands as soon as possible. Therefore, plans are to have Land Warrior proceed into production with the technologies that are mature at the time of the production decision. Further, the Army planned to produce and field 4,800 soldier systems, at a cost of about \$300 million before the more advanced technologies are expected to become available through the GEN II science and technology effort. Subsequent Land Warrior systems would begin to reflect GEN II technologies, and the first 4,800 systems would be retrofitted through a preplanned product improvement. Army officials commenting on a draft of this report told us that \$300 million was just a funding "buy-in" sufficient to equip perhaps one division.

Ability to Function With Other Components of the Digital Battlefield Has Yet to Be Demonstrated

To demonstrate successful digital battlefield integration prior to fielding, Land Warrior was to participate in ongoing advanced warfighting experiments. However, the Army does not plan to test whether the Land Warrior can successfully communicate through SINCGARS to the rest of the digital battlefield until after the production decision.

The ongoing advanced warfighting experiments, which test digital battlefield integration, have not had Land Warrior prototypes available for testing, as had been planned. In the Warrior Focus advanced warfighting experiment in November 1995, for example, Land Warrior participated only as an "observer." Because of the Land Warrior development schedule and the unavailability of prototypes, the Army procured less capable substitute soldier systems for the experiments. According to program officials, the Army has used various hybrid systems for its experiments.

The Army plans to begin fielding Land Warrior systems before other hardware and software components of the digital battlefield have been proven. However, according to Army officials, they are trying to synchronize the fielding of Land Warrior and "applique"—applications—software.⁶ Although Land Warrior may have some stand-alone value, it will not be fully utilized until other soldier system digital technologies have matured and are ready for insertion.

Recommendations

We recommend that the Secretary of the Army defer or restrict the purchase of Land Warrior systems until the Army (1) determines the Army

⁶"Applique" is the name in general use for what is formally known as the Force XXI Battle Command Brigade and Below (FBCB2) System. It consists basically of a laptop computer, FBCB2 applications software, a Global Positioning System receiver, and a communications interface.

acquisition objective, (2) resolves critical technical and human factor problems, (3) demonstrates successful digital battlefield integration with prototype systems, and (4) ensures that Land Warrior-equipped soldiers will outperform standard-equipped soldiers in head-to-head testing.

Because the cost to equip the contingency corps could exceed \$1.4 billion, we also recommend that the Secretary ensure that Land Warrior receive the monitoring and oversight appropriate for an ACAT II major weapons system.

Agency Comments

In commenting on a draft of this report, the Department of Defense (DOD) concurred with our recommendations. According to DOD, action is now being taken to determine user requirements—the Army acquisition objective and action is now underway to reclassify the Land Warrior program as an ACAT II, which requires a higher level of oversight and management attention. DOD's position is that the Land Warrior program will develop a system that meets performance requirements, to include human engineering and safety issues, before a production decision is made. DOD added that performance will be tested and evaluated according to requirements in DOD regulations.

DOD's comments are reprinted in their entirety in appendix I, along with our evaluation.

Scope and Methodology

We interviewed cognizant officials and examined pertinent documents related to Army policies and procedures concerning the Land Warrior program and its predecessor, the SIPE ATD. Additionally, we reviewed documents related to the GEN II and 21st Century Land Warrior initiatives. Materials examined included Land Warrior and SIPE test and evaluation reports that discussed various technical and MANPRINT issues and rated overall performance; program office and contractor reports and briefing summaries discussing program progress of Land Warrior and GEN II, and budget and user requirements documents.

We examined pertinent documents and interviewed officials closely affiliated with the Army's acquisition strategy as it existed before and after the November 1995 Defense Appropriations conference report directing the Army to submit a revised acquisition strategy by March 1, 1996, and accelerate development of the GEN II program. Finally, we reviewed plans and interviewed program officials to compare the timing of the Land

Warrior acquisition with other elements of the digital battlefield with which it must interface.

Locations visited included the Soldier Systems Command, and the Natick Research and Development Center, Natick, Massachusetts; Project Manager-Soldier, Fort Belvoir, Virginia; Department of the Army, Secretary for Research, Development, and Acquisition, Arlington, Virginia; and U.S. Infantry Center's Combat Development Directorate, Dismounted Battle Space Battle Laboratory, including the Land Warrior Modeling and Simulation Center, and the Training and Doctrine Command Systems Manager—Soldier, Fort Benning, Georgia. In addition, we met with various Land Warrior contractor officials at a technical conference in Orlando, Florida.

Our review was conducted from August 1995 to August 1996 in accordance with generally accepted government auditing standards.

We are sending copies of this report to other appropriate congressional committees; the Director, Office of Management and Budget; the Secretaries of Defense, the Army, the Navy, and the Air Force; and the Commandant of the Marine Corps. Copies will also be made available to others upon request.

This report was prepared under the direction of Thomas J. Schulz, Associate Director, Defense Acquisitions Issues. Please contact me at (202) 512-4841 if you or your staff have any questions concerning this report. The major contributors to this report were Charles F. Rey, Arthur S. Fine, Robert J. Dziekiewicz, and John M. Ficociello.

A handwritten signature in cursive script, reading "Louis J. Rodrigues". The signature is written in black ink and is positioned above the printed name and title.

Louis J. Rodrigues
Director, Defense Acquisitions Issues

List of Congressional Committees

The Honorable Strom Thurmond
Chairman

The Honorable Sam Nunn
Ranking Minority Member
Committee on Armed Services
Unites States Senate

The Honorable Ted Stevens
Chairman

The Honorable Daniel K. Inouye
Ranking Minority Member
Subcommittee on Defense
Committee on Appropriations
Unites States Senate

The Honorable Floyd Spence
Chairman

The Honorable Ronald V. Dellums
Ranking Minority Member
Committee on National Security
House of Representatives

The Honorable C.W. Bill Young
Chairman

The Honorable John P. Murtha
Ranking Minority Member
Subcommittee on National Security
Committee on Appropriations
House of Representatives

Comments From the Department of Defense



DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
3030 DEFENSE PENTAGON
WASHINGTON, D.C. 20301-3030



14 AUG 1996

Mr. Louis J. Rodrigues
Director, Defense Acquisition Issues
National Security and International Affairs Division
U. S. General Accounting Office
Washington, DC 20548

Dear Mr. Rodrigues:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "BATTLEFIELD AUTOMATION: Army Land Warrior Program Acquisition Strategy Is Too Ambitious," dated July 17, 1996 (GAO Code 707116/OSD Case 1193).

The Department's position is that the Land Warrior (LW) program is properly scoped and that it effectively integrates warfighting needs; research, development, test and evaluation efforts; and acquisition plans. The Department concurs with the report's two recommendations but asserts that some key points in the report are based on misinterpreted or incorrect information. The Department submits specific responses to the recommendations (enclosure 1), and general and specific comments (below). In addition, your staff agreed in discussions on August 8, 1996, to make several changes in the report; details are provided separately in a memorandum to the DoD Inspector General.

General Comments. FY 96 Appropriations Conference Report #104-344 expressed concerns about duplication and inefficient allocation of resources. In response, the Department revised the acquisition strategy of the LW Engineering and Manufacturing Development (EMD) and the Generation II Soldier (GEN II) Advanced Technology Demonstration (ATD). The revised strategy maintains LW as the initial system. LW fielding will begin in FY 00. The Science and Technology effort, now called Force XXI Land Warrior (FXXLW), was structured to provide operationally beneficial component upgrades for tech insertion. The principal disagreement between the Department and GAO report concerns the LW program's ability to mitigate human engineering issues before commitment to production. The Department's position is that the LW program will develop a system that meets the performance requirements, to include human engineering and safety issues, before a production decision is made. Performance will be tested and evaluated according to requirements of DoD 5000-series documents.



Appendix I
Comments From the Department of Defense

Specific Comments. The following comments address outdated information or misinterpretation:

RESULTS IN BRIEF (para. 1) says, "it is likely that certain key components will be late." While there are GFE components that are still in development, the Army is unaware of any components that will be late. The Modular Weapon System and Appliqué software are on schedule to meet program requirements, as explained during the meeting with GAO representatives on August 8, 1996.

TECHNOLOGY AND HUMAN FACTORS PROBLEMS (para. 1) says "The Army intends to commit to significant LW production before addressing certain technical, health and safety problems first identified during SIPE and LW Development." The system will be tested technically and operationally to ensure that it meets the system requirements (including those cited above) as outlined in the Operational Requirements Document for LW System (14 Apr 94) and the System MANPRINT Management Plan (SMMP) (10 June 94). Although Milestone III (production decision) is scheduled for January 1999, no funds will be committed to production until the system has successfully completed its Initial Operational Test and Evaluation (IOT&E) as tested by Test and Experimentation Command (TEXCOM) and evaluated by Operational Test and Evaluation Command (OPTEC).

MANPRINT is deeply embedded within every aspect of LW development, with MANPRINT personnel on every Integrated Product Team. Many of SIPE's MANPRINT deficiencies have been ameliorated in the first six months of LW development. As part of Integrated Product and Process Development, equipment is rapidly prototyped and provided to soldiers in an informal environment for initial user feedback, using the test-fix-test model. Risk Reduction #1 (RR1) was the first of these forums. Its purpose was to allow the contractor to obtain direct soldier feedback on initial designs. It highlighted areas of integration that require additional attention, many of which have already been corrected in the three months since RR1.

An independent assessment of the LW MANPRINT efforts was performed by the Army Audit Agency as part of a larger assessment of "Incorporating MANPRINT into Weapon System Development" (Audit Report AA 96-225, dated 30 May 96). It states that "We tested the applicable key management controls [for MANPRINT] for the Land Warrior System and concluded that all controls were in place and operating. The existence of these controls furnishes reasonable assurance that MANPRINT will be fully integrated and that the resultant system developed will enhance the soldier" (p.2, para. 4).

See comment 3.

See comment 4.

See comment 5.

TECHNOLOGY AND HUMAN FACTORS PROBLEMS (para. 1) also says, "some problems will not be resolved until after production begins." As discussed on August 8, 1996, disagreement with the report centers on capabilities demonstrated during SIPE that may prove beneficial to the soldier but that, technologically, are years away from being ready for transition to development (e.g. microclimate cooling). The Army has no current requirements for these capabilities in LW, nor are they candidates being pursued within the supporting FXXILW effort. The Army continues to monitor applicable state-of-the-art technologies and will reevaluate this decision when a technology breakthrough is achieved.

TECHNOLOGY AND HUMAN FACTORS PROBLEMS (para. 2) says "The Land Warrior program, which evolved from SIPE, has not demonstrated that it has resolved the problem of SIPE-equipped soldiers not performing as well as standard equipped soldiers, particularly in daylight." The SMMP identifies issues that must be resolved during development. LW has begun to address these issues in the first six months and will continue to focus on them throughout the program.

It states "Land Warrior also inherited other SIPE problems involving target recognition, hit performance, navigation, health and safety, and other factors." The physical equipment being developed in LW is substantially different from SIPE, though it provides capabilities that were demonstrated/validated during the SIPE ATD. Human factors and safety concerns raised during the SIPE demonstration formed the basis for many of the issues included in the LW SMMP. For example, the SIPE helmet assembly weighed more than 7 pounds. Head-borne weight limit for LW is 5.5 pounds (equivalent to the weight of standard helmet and night vision device). Requirements for proper helmet assembly balance are contained in the LW contract. The display placement and helmet suspension are being designed with a concern for center of gravity. Per FY 96 Appropriations Conference Report #104-344, the FXXILW program will continue to investigate alternative helmet designs and materials to further reduce LW risk.

See comment 6.

The heaviness of the laser rangefinder was recognized as a problem during RR1. The mock up device used during that exercise was 24 pounds, equivalent to the requirements for the LW Early Operational Experiment. The system requirement is less than 2 pounds and a plan exists to achieve the required weight.

TECHNOLOGY AND HUMAN FACTORS PROBLEMS (para. 3) says "the overall Land Warrior system will not be measured against standard-equipped soldiers, as SIPE was". The LW Test and Evaluation Master Plan (TEMP) (pg. IV-1, para. 4.1d) states, however, that "Land Warrior system performance will be compared

Appendix I
Comments From the Department of Defense

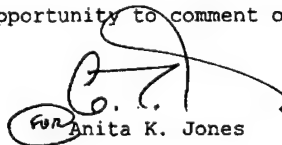
See comment 7.

to standards in the Critical Operational Issues and Criteria (COIC) and the ORD and, as required, to the performance of soldiers using equipment available to units at Land Warrior's Initial Operational Capability (IOC) date." The TEMP (pg. IV-6, para. 4.4,d,(3) - IOT&E Events, Scope of Testing and Scenarios) states, "The unit must be equipped with all required standard equipment for test events that require a baseline comparison." The subparagraph describing phase one (weapons firing) of IOT&E calls for baseline testing when "adequate data are not available from previous testing." The subparagraph describing phase two (individual and collective nonfiring exercises) of IOT&E states, "The squads and platoons will conduct offensive and defensive force on force exercises in both the LW and the baseline configuration for comparison."

See comment 8.

ABILITY TO FUNCTION WITH OTHER COMPONENTS OF THE DIGITIZED BATTLEFIELD HAS YET TO BE DEMONSTRATED (para. 1-2) says "the Army does not plan to test whether Land Warrior can successfully pass through SINGARS to the rest of the digitized battlefield until after the production decision." The LW ORD (pg.5, para. 4.a.(2)(a)) requires that "The radio module for leaders must be functionally compatible with the SINGARS family of radios." This requirement is listed on the critical technical parameters matrix in the LW TEMP. During IOT&E, "The test unit will consist of battalion elements (command and control) and a light infantry company (TEMP, pg.IV-6, para. 4.4d.(3))." The battalion and company nets are both SINGARS nets. As mentioned previously, LW will use Appliqué' software. Interoperability will be demonstrated at the Digitized Interoperability Lab (DIL) at CECOM and tested/evaluated during DT and during IOT&E. Tactical messages must be passed over SINGARS for the units to successfully operate during IOT&E. Limited quantities of LW systems will be used during the Appliqué' Force Development Test & Experimentation and IOT&E (schedule TBD) for dismounted soldiers.

Thank you for the opportunity to comment on the report.



Anita K. Jones

Enclosure

cc:
Assistant Secretary Of The Army (Research, Development and Acquisition)
Deputy Chief Of Staff For Operations And Plans (DAMO-FDD)
Commander, US Army Soldier Systems Command (AMSSC-OP)
Commander, US Army Infantry School (TSM-SOLDIER/ATZB-TS)

GAO DRAFT REPORT DATED JULY 17, 1996
(GAO CODE 707116) OSD CASE 1193

"BATTLEFIELD AUTOMATION: ARMY LAND WARRIOR PROGRAM ACQUISITION
STRATEGY IS TOO AMBITIOUS"

DEPARTMENT OF DEFENSE COMMENTS TO THE GAO RECOMMENDATIONS

- ° RECOMMENDATION 1: The GAO recommended that the Secretary of the Army defer or restrict the purchase of Land Warrior (LW) systems until the Army (1) determines the Army Acquisition Objective, (2) resolves critical technical and human factors problems, (3) demonstrates successful digital battlefield integration with prototype systems, and (4) ensures that Land Warrior-equipped soldiers will outperform standard-equipped soldiers. (p. 7/GAO Draft Report)

DOD RESPONSE: The Department concurs. Data supporting each of the four conditions must be available prior to Milestone III, Production Decision. Each has been or is being addressed in the LW program, as follows:

- (1) The Army Acquisition Objective for LW is 34,000 systems, to equip the appropriate soldiers in Force Package 1 and 2 units.
- (2) A MANPRINT program with incremental testing is in place to resolve MANPRINT issues. The program's System MANPRINT Management Plan (SMMP) identifies the issues that must be resolved. The contractor is required to address these issues during the design and development. Recently, the Army Audit Agency performed a MANPRINT audit of several Army programs and gave LW positive remarks.
- (3) Contractual requirements are in place to have LW totally interoperable with the digitized battlefield. The Army Digitization Office and the Army System Engineering Office are participants in the LW Computer/Radio and Software Integrated Process Teams to ensure compatibility with Force XXI. Prior to Development Testing, the LW program must demonstrate integration into the digitized battlefield in the Digital Integration Lab at the US Army Communications-Electronics Command. This integration will be verified during the LW DT and Initial Operational Test and Evaluation (IOT&E) and during Appliqué' Force Development Test and Experimentation and Operational Testing.
- (4) Testing against standard-equipped soldiers will occur during IOT&E, as outlined in the LW Test and Evaluation Master Plan, dated 14 Jul 94.

Enclosure (1)

- ° RECOMMENDATION 2: Because the cost to equip the contingency corps will likely exceed \$1 billion, the GAO also recommended that the Secretary ensure that LW receive the monitoring and oversight appropriate for an ACAT II major weapon system. (p. 7/GAO Draft Report)

DOD RESPONSE: The Department concurs. Under the original acquisition strategy and President's Budget FY 97, covering FY 97-01, LW was to be an ACAT III program. However, because of the emphasis on the individual soldier and the revolutionary step forward provided by LW, it has received informal attention and oversight at the Army's Secretariat Executive level. The level of investment in LW is anticipated to exceed the threshold for ACAT II programs in the FY 98 Budget Estimate Submission. Army is initiating the process for designation as an ACAT II program.

The following are GAO's comments on the Department of Defense's (DOD) letter dated August 14, 1996.

GAO Comments

1. Suggested technical changes have been incorporated in the text of the final report.

2. The congressional concerns expressed in the conference report also dealt with which system architecture—Generation II Soldier System (GEN II) or Land Warrior—would be chosen as the Army's future soldier system. The conference report called for GEN II to be continued as the objective system, with Land Warrior providing interim support. The Army's revised strategy made Land Warrior the primary system and relegated GEN II to the science and technology component of the Land Warrior program.

We recognize that efforts will be made to reduce engineering and technical problems over the remaining 2 years before engineering and manufacturing development is to be completed. However, our purpose was to point out that solving all the engineering and technical problems in the relatively short time established to field the Land Warrior system presents significant challenges. This, coupled with the many, not yet developed technology insertions planned for Land Warrior under GEN II creates such elevated risks that close scrutiny is appropriate. To date, most of Land Warrior's presumed ability has been based on the results of Advanced Technology Demonstrations (ATD), computer modeling, and experiments using surrogate or other hybrid equipment configurations. This approach may be sufficient to predict the feasibility of a system but cannot be relied upon to gauge the extent to which Land Warrior will improve existing soldier capabilities. We believe that a strong focus on prototyping and testing before a production decision is made is essential to ensure program success and determine the worth of the Land Warrior system.

3. Report text has been changed.

4. Although the Army is attempting to address a number of problems, we point out that not all the technology and human factor problems associated with the Army's integrated soldier system are reflected in the Land Warrior Organizational Requirements Document. These include such problems as cognitive and physical overload, heavy and cumbersome

equipment configuration, and other health and safety issues. These issues may well transcend the Land Warrior acquisition.

5. While it may be true that the Army has no current requirement to solve some of these problems, they are problems nonetheless. It is precisely the significant technological challenge they impose that dictated their postponement. For example, the microclimate cooling system, which was part of the GEN II system architecture, was deferred because of power requirements plus weight and cost considerations.

6. We recognize that DOD is trying to address the Soldier Integrated Protective Ensemble (SIPE) problems, to the extent possible during Land Warrior development. Nevertheless, both sets of problems—those that are part of the current Land Warrior effort and those that are being deferred—must be resolved at some point. For example, during SIPE, helmet weight and balance resulted in soldiers experiencing difficulty lifting their heads to fire from the prone position. DOD plans to resolve this problem during Land Warrior development. However, enhanced hearing, still considered an important technology component, was deferred until after production because the device interfered with the soldier's ability to move quietly and avoid detection.

7. Although the Test and Evaluation Master Plan makes reference to the use of comparative testing under certain limited conditions, much of the required testing would use standardized test results and not require the same "head-to-head" testing that SIPE equipment experienced.

8. DOD indicates that Land Warrior is required to demonstrate compatibility with Single Channel Ground and Airborne Radio System (SINCGARS) at battalion level and below. However, Land Warrior must communicate with higher command levels as well. The ability of Land Warrior to successfully demonstrate interoperability through SINCGARS has been limited by two factors—(1) advanced warfighting experiments to date have been at battalion level or below and (2) only hybrid or substitute equipment has been used in these experiments because of the unavailability of Land Warrior prototype components.